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Quantifying the effect of varying sediment flux on landscape dynamics and stratigraphy

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The rate of sediment supplied from catchments to sedimentary basins imparts key information about climatic, tectonic, and anthropogenic influences (allogenic forcing). This is because sediment supply is a major control on landscape dynamics and the sediment transport systems, and this in turn dictates the character of the stratigraphic record. Given this, any changes in the characteristics of the stratigraphic record are usually interpreted in terms of allogenic forcings. However, we know that landscapes and sediment transport systems are strongly affected by mechanisms internal to the transport system (autogenic processes). In the case of terrestrial systems, the characteristic autogenic process is river avulsion, which has the effect of temporally varying sediment distribution over basins. Autogenic processes will therefore obscure sediment supply signals generated by allogenic forcing, but we hypothesize that this effect will occur only within the confines of autogenic behaviour. To formalize this hypothesis we develop a new theoretical framework, supported by a suite of aggrading physical delta experiments, which predicts the minimum magnitude for allogenic sediment supply signals to be stored in stratigraphy. We test this theory by constructing several experimental deltas each forced with different magnitude and period sediment supply cycles. The results of the experiments support our initial hypothesis and theoretical framework, which is a major step in predicting the response of landscapes to environmental signals and accurately interpreting the stratigraphic record for past environmental change.